Health Usage Monitoring System (HUMS)

Federal Aviation Administration

Presented to: 2006 Rotorcraft Directorate Designee Conference (Arlington, TX)

By: Jorge Castillo, Rotorcraft Directorate/ASW-111

Date: May 25, 2006

OUTLINE

- Definition/Types of HUMS
- Benefits of HUMS
- Certification Regulations & Guidance
- Certification Approach

HUMS?

- HEALTH USAGE MONITORING SYSTEM (HUMS): Equipment, Techniques And/Or Procedures By Which Selected Incipient Failure Or Degradation And/or Selected Aspects Of Service History Can Be Determined.

Types of HUMS

- HEALTH MONITORING SYSTEM: Used For Monitoring Health Of Aircraft Parts and/or Systems
- USAGE MONITORING SYSTEM: Used For Monitoring Usage of Aircraft Parts and/or Systems

Types of HUMS
(Usage/Health Monitoring Examples)

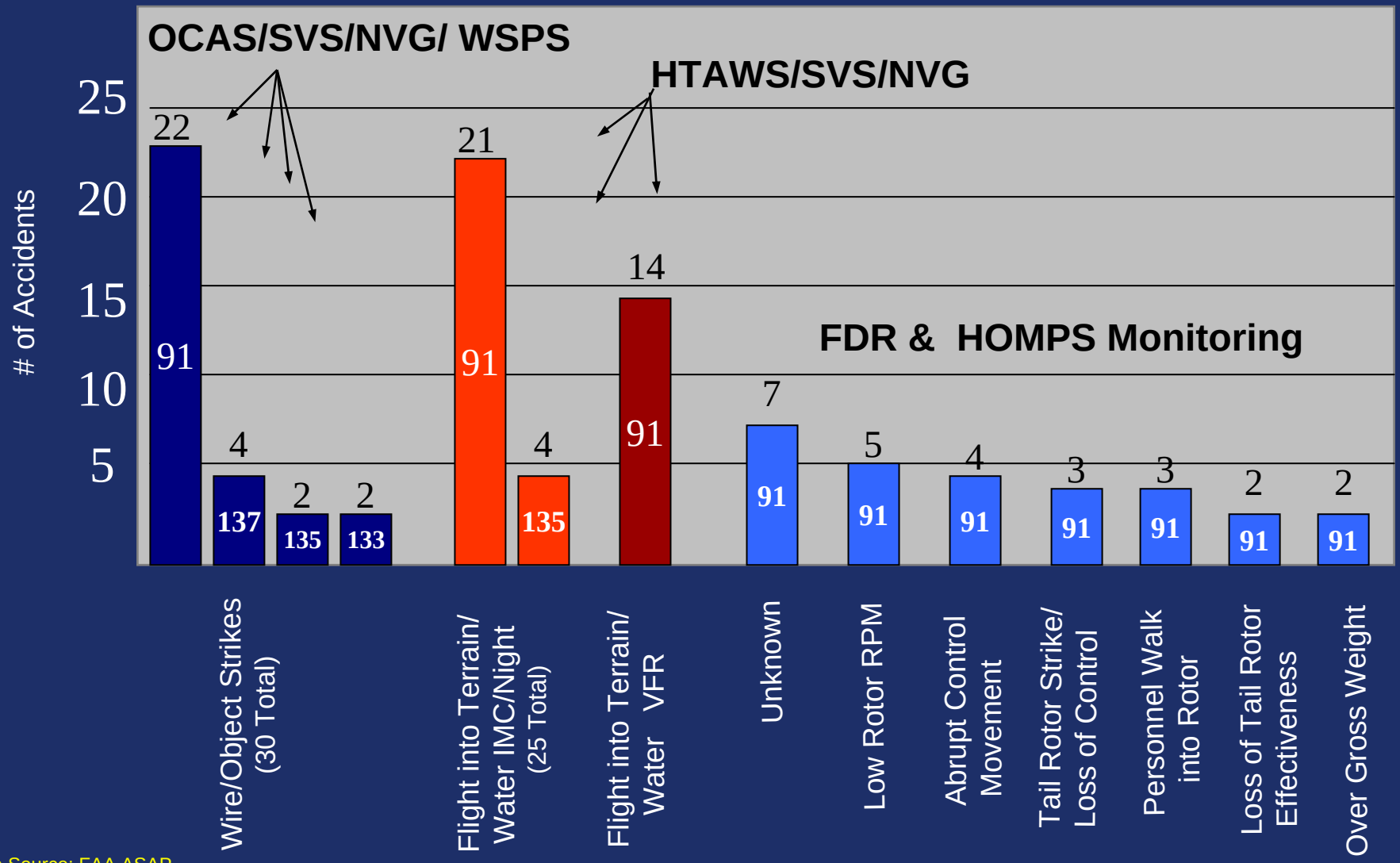
- Determines Part Effective Usage Hours (instead of actual hours) based on Flight Condition Recognition or Direct Measurements
- Can Extend/Shorten Replacement Interval of Critical Parts and TBOs
- Monitor Engine & Drive System Vibration
- Rotor Track & Balance Diagnostics
- Monitor Engine Limit Exceedance Data

HUMS Benefits

- Maintenance Cost Benefits
  - Extending replacement interval for Critical Parts
  - Extending/Eliminating Inspection intervals
  - Extending TBOs.

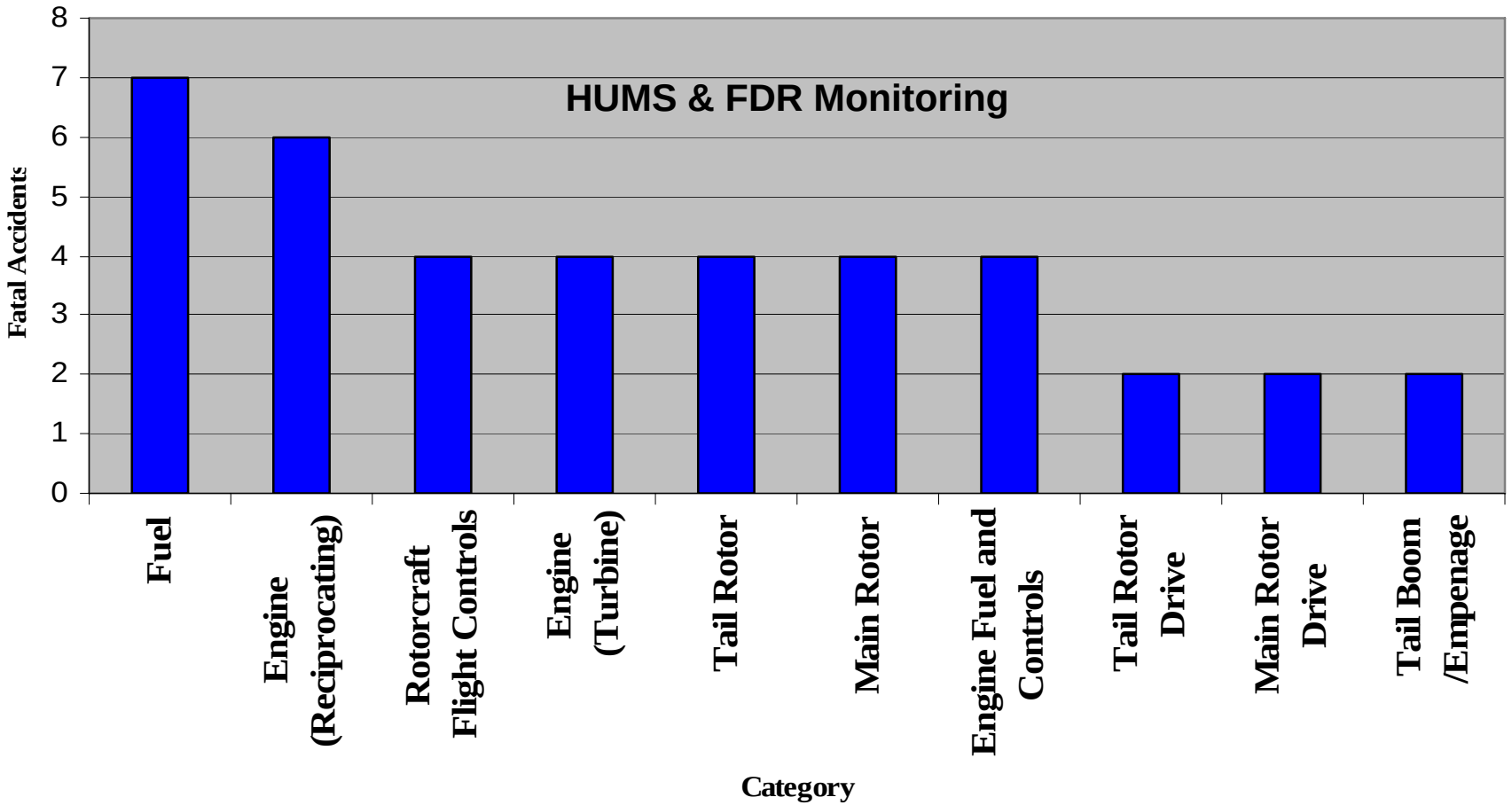
- Safety Benefits
  - Replacement of Critical Parts before they fail.
  - Detection of impending failures by health monitoring aircraft systems (e.g. transmission, tail rotor drive shaft, etc.)

Top Operational Causes of Fatal Rotorcraft Accidents 1994 - 2004



Data Source: FAA ASAP

Top Ten Mechanical Causes of Fatal Rotorcraft Accidents 1994 - 2004



Data Source: FAA ASAP (SDR Database)

Regulations & Guidance

- HUMS Is Not A Required System
- AC Provides Guidance For Certification of HUMS Installations Via STC, TC.
  - AC 27-1B & AC 29-2C, Change 1, Section MG15
  - Rotorcraft Health Usage Monitoring System Advisory Group (RHUMSAG) Committee
  - Committee Members: FAA Certification & Flight Standards, European Joint Airworthiness Authorities (JAA), US & European Industry Groups (AIA & AECMA)

Regulations & Guidance

(AC Definitions)

- END to END
- HUMS
- Credit
- Applications
- Criticality
- Integrity
- Mitigation Action
- Commercial-Off-the-Shelf (COTS)
- Independent Verification Means
- Synthesis

Regulations & Guidance

(AC Definitions)

- AC Requires HUMS Application For Which CREDIT Is Sought To Be Validated.
- CREDIT Is A HUMS Application That Adds To, Replaces, Or Intervenes In Industry Accepted Maintenance Practice Or Flight Operations

Certification Approach
(Elements of a HUMS)

- Airborne Data Acquisition System
  - Records Data Such as Pressure Altitude, Engine & Rotor Torque, Indicated Airspeed.
- Display ISPLAY SYSTEM
  - Provides HUMS Related Information to Pilot
- GROUND PROCESSING SYSTEM
  - Contains HUMS Processing Algorithms
  - Can Consist of COTS Hardware/Software

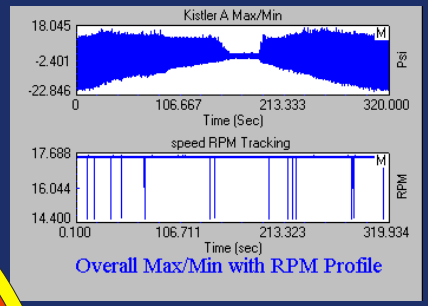
Certification Approach

Onboard Systems

INSTALLATION

Sensors

Algorithms



CREDIT VALIDATION

Hardware
And
Software

Maintenance and Support System Interface

INSTRUCTIONS FOR CONTINUED AIRWORTHINESS

Certification Approach

1. Determine if HUMS will be for “credit” or “no credit”.
2. Perform End-to-End Criticality Assessment (i.e. FHA)
3. Identify any Mitigating Actions that may allow reduction in Qualification Levels for Airborne H/W & S/W.
4. If Groundstation utilizes COTS, propose Independent Verification Means.
5. Qualify Airborne H/W & S/W and Groundstation

Certification Approach
(Definitions)

- Mitigating Actions can result in modification of level of qualification (Mitigating Action: An autonomous and permanent compensating factor, i.e. independent check)
- Independent Verification Means (IVM) is a means for qualifying ground station COTS intended to gain confidence in the COTS operational reliability.
- End-To-End Assessment shall consider safety effect that the HUMS application can have on the aircraft based on the use of the data in relation to the defined credit.

Certification Approach

6. Obtain installation approval for HUMS (STC/TC)
   - Retain traditional maintenance program reqmts. (no “credit” use granted yet)
7. Begin Credit Validation of HUMS
   - Intended to Validate HUMS functions as intended
   - HUMS “Credit” granted once completed along with ICA requirements

Certification Approach
(ICAs & Other Data Reqmts.)

8. Provide ICA & other data
   - ICA
   - Operator's HUMS Program,
   - HUMS Training Program, and
   - Master Minimum Equipment List
     - Allowances are determined based on the criticality of the system.
9. Obtain approval to use HUMS as a “Credit” system.

True or False?

- AC defines what functions must be implemented in HUMS?
- If HUMS results in addition of new maintenance requirements, it is now considered a “for Credit” system?
- AC requires that HUMS S/W be Level A for system that allows extension of replacement interval for critical structural parts?
- Probability of loss of HUMS $\leq$ 1 x 10-9 for this example?

True or False?

- Mitigating Action is a permanent certification requirement?
- Independent Verification Means is a permanent certification requirement?
- Once HUMS installation is approved, it can be used on a “for credit” basis?
- If HUMS that tracks critical parts usage hours is approved for “Credit”, aircraft cannot dispatch if system is not operational?

QUESTIONS?